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SOIL CONSERVATION

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SOIL CONSERVATION •

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EZRA TAFT BENSON
SECRETARY OF AGRICULTURE

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★ THIS MONTH ★

	PAGE
SALINE AND ALKALI SOILS *By H. E. Hayward*	75
FAMILY OF WINNERS *By John H. Gibson*	81
BOOKS IN RUNNING BROOKS *By William A. Breyfogle*	82
BEE PASTURES IN THE CONSERVATION PLAN *By Arthur B. Beaumont*	84
LOAD BY LOAD, THEY PUT IT BACK *By J. M. Rabdau*	88
BANKERS SPUR WORK *By Arthur Sullivan*	90
SEVEN WEEKS OF LIVING WITH SOIL AND TREES *By R. N. Hoit*	92
REVERSE IRRIGATION *By Hylon C. Smith and William R. Ratledge*	93
CURVED FIELDS vs. SQUARE ONES *By Villard W. McLaughlin*	94
"DEAD" SOIL COMES TO LIFE *By W. R. Elder*	95

WELLINGTON BRINK
Editor

SOIL CONSERVATION is published by direction of the Secretary of Agriculture as administrative information required for proper transaction of the public business. The printing of this publication has been approved by the Bureau of the Budget, July 29, 1954. SOIL CONSERVATION supplies information for workers of the Department of Agriculture and others engaged in soil conservation.

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NATURE'S CONSERVATIONISTS.—Farmers living in the headwaters area of Perche Creek in Boone and Randolph Counties (Mo.) credit beaver with providing their main supply of livestock water last summer.

In an 8-mile area of upper Perche, the stream would have been completely dry except for the dam-building paddletails.

In one fisheries study 26 major beaver dams were counted that impounded water from waist to shoulder depth. Numerous lesser dams were also found for a total of 48 in the upper 4 miles. The beaver pools contained bullheads, green sunfish, carp suckers, redhorse and bass.

WELL SAID!—There recently appeared in the *Bergen Evening Record*, Hackensack, N. J., an AP dispatch which read:

"LOST MOISTURE—Hastings, Nebr. (AP)—After a heavy rain, a farmer complained: "I had 110 percent runoff—100 percent water and 10 percent farm."

This really is most graphic and expressive . . . I have never seen anything drive home more simply and effectively the point of farm soil erosion.

—Hiram B. D. Blauvelt

FRONT COVER.—The reward for a conservation program that includes wildlife! This hunter, at the end of day, returns home with a fat cock pheasant. Gordon S. Smith caught this excellent sunset silhouette in Lancaster County Pa.

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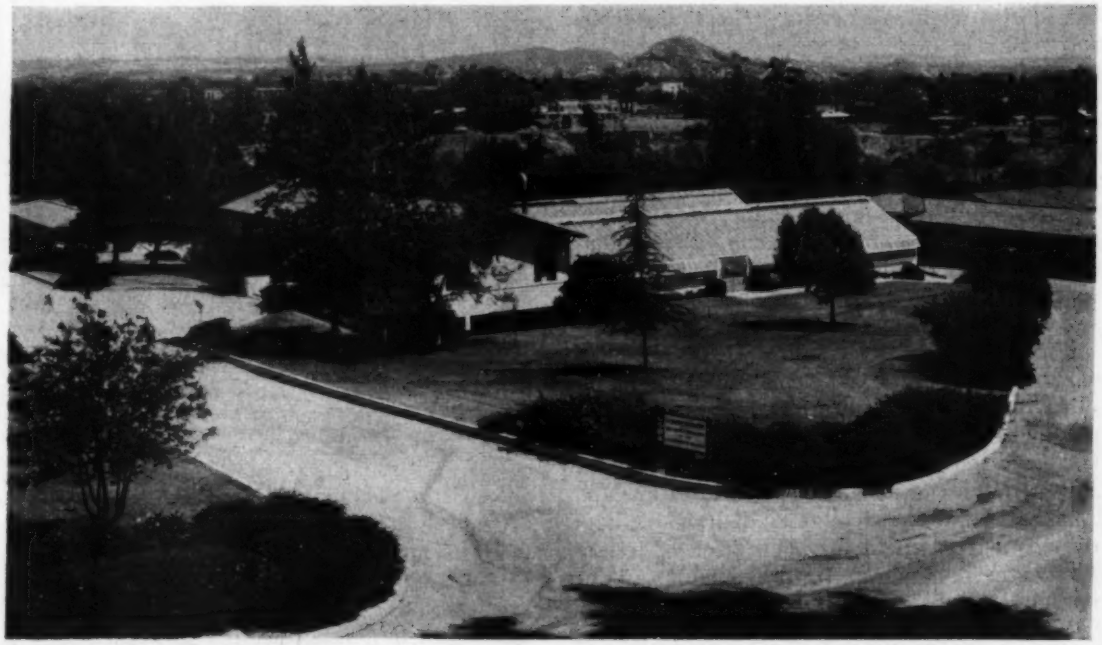
Saline and Alkali Soils—Their Diagnosis and Improvement

A report on the salt problem in irrigated agriculture, and on the work of the U. S. Salinity Laboratory.



The U. S. Salinity Laboratory, Riverside, Calif., showing main building, greenhouses, and buildings housing soils laboratories, machine shop, and conference room. The Rubidoux unit is not shown.

By H. E. HAYWARD

THE salts of the earth are essential to life on our planet. It would be impossible to grow the crops needed for fiber, food, fuel, and shelter without salts containing nitrogen, phosphorus, potassium, calcium, magnesium, and other nutrient elements which contribute to soil fertility. On the other hand, if the amounts of chlorides, sulfates, borates, and carbonates are high, saline and alkali soil conditions are likely to occur, and these constitute a salt problem which is a major consideration in the maintenance of a stable irrigated agriculture.

In general there is a close correspondence between the occurrence of salty soils and low rainfall. Saline and alkali soils are seldom found in regions where rainfall is sufficient for agriculture because rainwater is essentially free from salts and the soluble material is leached from the root zone of the soil profile and carried away in the drainage water. Thus, the salt problem is peculiar to regions of arid and semiarid climate where irrigated agriculture is practiced, and rarely occurs in humid regions, except in cases where the soil has been inundated

Note:—The author is director, U. S. Salinity Laboratory, Riverside, Calif.

by sea water in river deltas and other low-lying lands near the sea.

The original source of the salt constituents is from the primary minerals that are found in soils and in the exposed rocks of the earth's crust. For example, it has been estimated that the average chlorine and sulfur contents of the earth's crust are 0.05 and 0.06 percent respectively, and sodium, calcium, and magnesium occur in amounts of 2 or 3 percent. Although weathering of the primary minerals constitutes the source of all soluble salts, there are probably few cases where this process alone results in a saline soil. In most cases, saline soils are formed by the transport of salts from other locations by water. The ocean is also a source of salts and many marine deposits such as the Mancos shales which occur in Colorado, Utah, and Wyoming are high in saline constituents. Less frequently, as in some parts of Australia, salt is moved inland by the transportation of spray by winds. The most common direct source of salt is from surface and ground waters, all of which contain dissolved salts in varying concentrations. These waters may add salts to soils as a result of flooding of low-lying land or because the ground water rises close to the surface. When used for irrigation, waters act as sources of salt and the salinization and alkalization of extensive areas of irrigable land may be attributed to the application of irrigation water that is high in total soluble salts or in sodium.

Irrigated agriculture is the backbone of the economy of many of the Western States; and, because irrigation and the salt problem are closely related, the extent of irrigation is significant. According to the Agricultural Census of 1950, the acres in irrigation on farms in the 17 Western States were: Pacific States, 8,334,169; Mountain States, 11,642,484; and Plains States, 4,292,263—a total of 24,268,916 acres from 33,850 reporting farms. This represents an increase of over 7,000,000 acres since the Census of 1940. Hawaii has approximately 117,000 acres under irrigation. In 1950 irrigation in the 31 Eastern States involved approximately 1,500,000 acres, an increase of about 100 percent since 1940.

What is the extent of the salt problem in irrigated areas? No precise answer can be given because of a number of factors. These include

Saline soil in the Grand Valley, Colo., showing salt accumulation in the furrows of an abandoned field. The salt content of the soil in the root zone exceeded 2 percent on a dry-weight basis.

the absence of complete data based upon reliable soil surveys, the constantly shifting intensity of the salinity hazard, reflective of good or unsatisfactory methods of land and water management, and the wide variation in injury due to salt which may range from slight reductions in yield to severe or complete loss of crops and outright abandonment of irrigated lands. Estimates of the magnitude of salt injury vary from 12 percent of the irrigated land to as much as 25 or 30 percent. The latter estimates are based on surveys which in some cases include potential irrigable lands as well as those now under irrigation.

Salty soils are those which contain too much soluble salts or too much sodium or a combination of the two conditions. A better understanding of the salt problem is possible if the characteristics of saline and alkali soils are understood. The U. S. Salinity Laboratory has defined these soils in non-technical terms as follows: a *saline* soil refers to a low sodium soil that contains sufficient soluble salts to impair its productivity; an *alkali soil* contains sufficient

exchangeable sodium to interfere with the growth of most crop plants; and a *saline-alkali soil* is one which is both saline and alkali. This classification is based upon measurements of the concentration of the solution extracted from a saturated sample of the soil as determined by an electrical conductance method, and the exchangeable-sodium percentage of the soil as determined by chemical analysis. In each case, limits and standards have been set up which are determined by precise measuring methods.

The threat of salinity and sodium problems has long been recognized, and soil scientists and agricultural workers of State and Federal agencies have contributed many valuable research findings bearing on these problems. It is generally agreed that the salt problem is a regional one, and the passage of the Bankhead-Jones Act in 1935 provided for additional assistance in its solution by making Federal funds available for agricultural research on regional problems. At a conference held in Salt Lake City

A saline-alkali soil in the delta area, Utah, showing white crust and salt puffs characteristic of highly saline conditions. Exchangeable sodium was high, but the soil contained sufficient gypsum so it could be reclaimed by leaching without the use of amendments.

in 1937, among representatives of the agricultural experiment stations of the Western States and the U. S. Department of Agriculture, agricultural problems of regional importance were considered. It was agreed unanimously that the salt problem in irrigation agriculture merited first priority; and it was decided to establish a Federal laboratory at Riverside, Calif., to conduct research on problems connected with the success and permanence of agriculture on saline and alkali soils.

A moist alkali spot, "black alkali," in the Emmett Valley, Idaho. The problem soils in this area are characterized by low salinity, high sodium percentages, high water tables, and low rates of infiltration and permeability.

In 1938 a site was selected at the foot of Mount Rubidoux, about a mile from the center of the city and adjacent to the Rubidoux Laboratory, which was organized in 1928 to conduct research on the quality of irrigation water and the toxicity of boron to plants. Because their activities were so closely related the Salinity and Rubidoux laboratories were combined in one organization in 1948. Owing to the occurrence of the salinity problem in the 6 Plains States and the interest of state research workers in the program of the laboratory, official cooperation was extended, in 1951, to include all of the 17 Western States and Hawaii. The Laboratory is now under the administration of the Soil and Water Conservation Research Branch in the Agricultural Research Service.

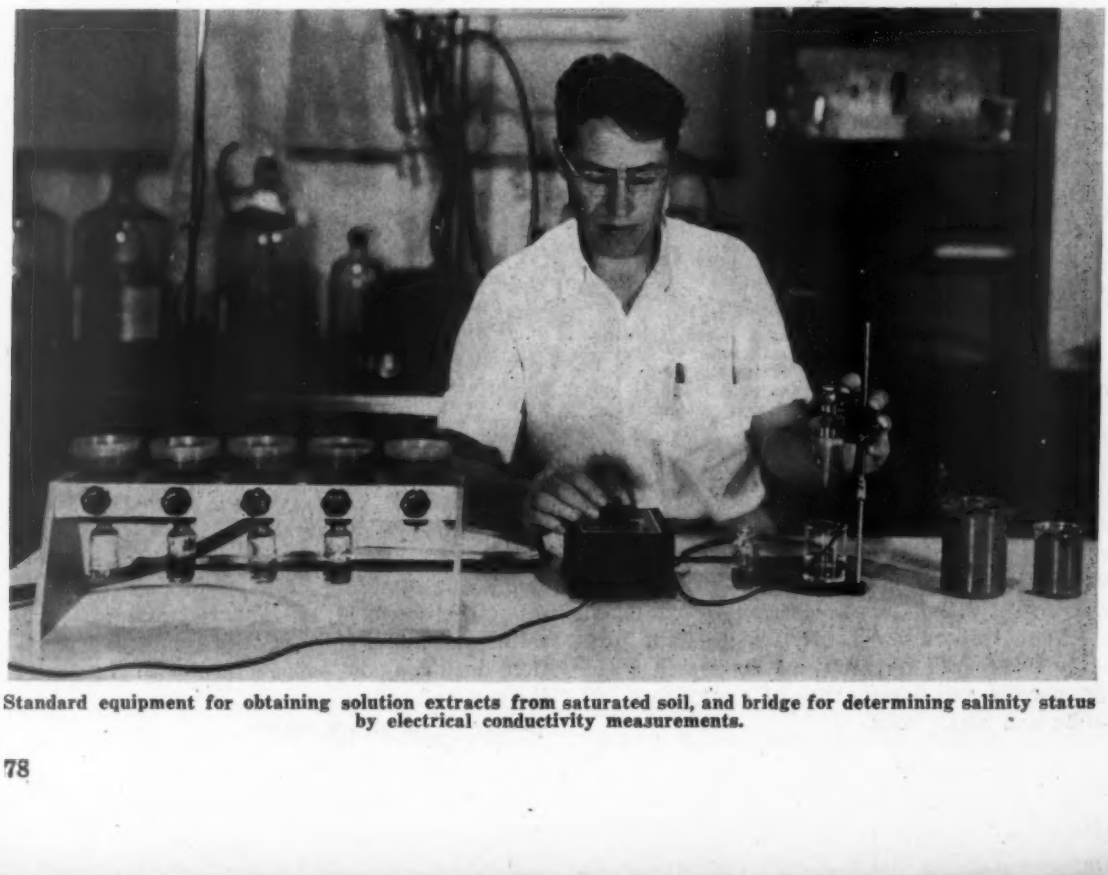
The Salinity Laboratory is unique in being the only research institution which is devoted exclusively to the study of the salt problem. The staff consists of a closely-knit group of scientists who are specialists in the fields of soil physics, soil chemistry, water chemistry, plant physiology, and agricultural engineering. Including the supporting group of sub-professionals and clerical personnel, there is a total of 35 members on the staff.

The research program of the laboratory includes the study of crop production on salty soils; the chemical and physical properties of saline and alkali soils as they relate to irrigation, drainage, and soil management practices; the salt and sodium tolerance of crops; and the quality of irrigation water.

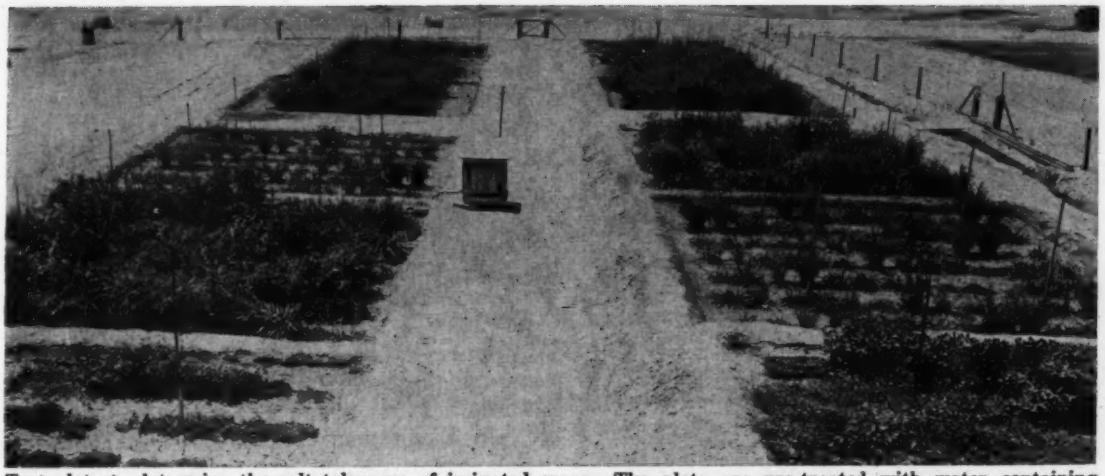
Problems that have been studied and the progress that has been made are illustrated by the following examples. The diagnosis and improvement of saline and alkali soils would be impossible without accurate measuring methods to determine their chemical and physical properties. An important objective of the research program has been to develop new or improved methods for chemical analysis, and special equipment for measuring physical characteristics of soils and determining the moisture status of soils. For example, recent improvements have been made in a soil solution extractor and an electrical conductivity bridge for the determination of the salinity of soil and irrigation water. The new equipment combines portability at a low cost with sufficient accuracy for diagnostic purposes. A more widespread appraisal of saline soils should help to avoid the failures which farmers may experience when crops are planted in questionable areas without advance information concerning salinity. New chemical methods which have been developed include procedures for determining the amount of exchangeable sodium and magnesium in soils. Without such information, it would be impossible to decide upon the amounts of gypsum or other soil amendments which may be required to reclaim saline-alkali and alkali soils.

Current studies on the salt and sodium tolerance of important crop plants include investigations on fruit trees, forage, and vegetable crops; lists of crops showing their relative salt tolerances are now available to agriculturists. Information on the salt tolerances of crops may mean the difference between success or failure in cases where the soil is slightly to moderately saline. The relationship of planting and irrigation methods to the germination of row crops on saline soils is being investigated in cooperation with the Southwestern Irrigation Field Station at Brawley, Calif. It has been found that in soils where salinity is a factor, the use of modified practices of planting row crops may increase the emergence of germinating seeds of some species by as much as tenfold.

The quality of water used for irrigation is an important consideration in western agriculture. Studies have been conducted on the occurrence of boron in toxic quantities, and on



Standard equipment for obtaining solution extracts from saturated soil, and bridge for determining salinity status by electrical conductivity measurements.



Test plots to determine the salt tolerance of irrigated crops. The plots are pre-treated with water containing sufficient salt to establish the required soil salinity levels for tolerance tests.

the effect on soils of using waters containing excessive amounts of bicarbonate. A revised classification of waters based on their suitability for irrigation has been developed, which takes into account the salinity and the sodium content as hazards to crop production. Salt-balance studies have been conducted in cooperation with other agencies to determine the trend of salt accumulation in several of our important watersheds. These investigations provide useful information as to whether or not current methods of irrigation and drainage are adequate to control the salinity problem.

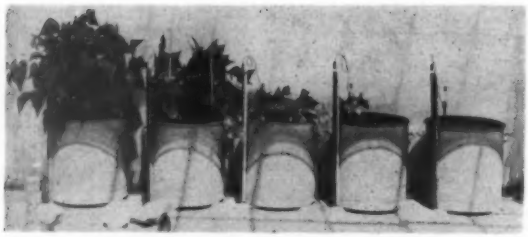
Staff members also serve as advisors to State and Federal agencies in technical matters related to saline and alkali soils. Since its establishment in 1938, the laboratory has cooperated in more than 40 projects which have been undertaken in all of the Western States and Hawaii. The objectives of these cooperative investigations cover a wide range of subjects, including characterization and classification of saline and alkali soils, field methods for the control of salinity by drainage, reclamation of saline and saline-alkali soils by leaching, use of soil amendments to reclaim alkali soils, and the relationship to sodium soils of soil-moisture characteristics such as soil permeability and infiltration rates.

Investigations on the control of saline and alkali conditions may be illustrated by the studies in California, Colorado, Idaho, and Oregon.

In the field of agricultural engineering, a project is in progress in the Coachella Valley, Calif., to determine the quantity of water required to leach excess salts and boron from highly saline soils. This work is in cooperation with the California Agricultural Experiment Station, the Coachella Valley County Water District, and the Bureau of Reclamation.

In the San Luis Valley of Colorado where sub-irrigation is the common practice, a reclamatian experiment is in progress on coarse-textured, saline-alkali soils to determine the effects of pre-leaching, application of gypsum and calcium chloride as soil amendments, the use of soil conditioners, and the maintenance of high and low ground-water levels on crop growth. Preliminary results indicate that these high-sodium soils can be reclaimed by leaching alone and that favorable soil-moisture relations under the permeable soil conditions encountered are more easily maintained by sub-irrigation than by surface flooding. This study is in cooperation with the Colorado Agricultural Experiment Station, the Bureau of Reclamation, and the Western Soil and Water Management Section of the Soil and Water Conservation Research Branch.

Investigations of salinity and alkali conditions in the Emmett Valley, Idaho, have been completed recently. The saline, alkali, and drainage conditions in the area were characterized, and survey tests and methods which can be used for mapping saline and alkali conditions in this and other problem areas were evaluated.



Testing for alkali tolerance. The drums contain soil adjusted to increasing levels of exchangeable sodium: from left to right—4, 23, 37, 48, and 58 per cent. (Upper) Green beans, a very sodium-sensitive crop; (lower) table beets, a relatively sodium-tolerant crop.

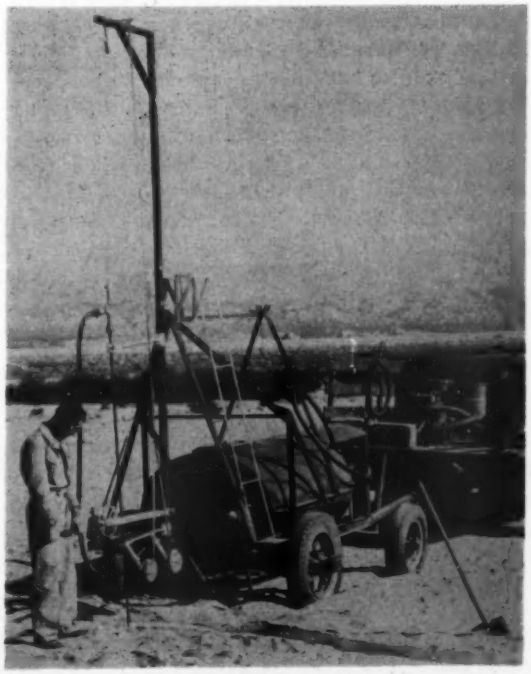
The Idaho Agricultural Experiment Station and the Division of Soil Survey cooperated in the survey.

Field tests on the Owyhee Project, Oreg., were undertaken with the cooperation of the Oregon Agricultural Experiment Station, the Soil Conservation Service, the Bureau of Reclamation and the Western Soil and Water Management Section. The objectives were to investigate the reason for low infiltration rates, and to study methods of improving alkali soil with manure and chemical amendments. The results, published in a bulletin of the Oregon station, indicated that application of manure plus gypsum, manure plus lime, manure, and gypsum, in that order, were most beneficial in increasing the soil infiltration rate.

If the research of today is to become the science which serves the agriculture of tomorrow, there must be effective means of intercommunication between research agencies and those that are engaged in field programs concerned with the conservation of soil and water and the production of agricultural crops. The Salinity Laboratory provides for the dissemination of results of its research through a system of state collaborators, by means of conferences with personnel of other agencies, through the publications issued by the Laboratory, and, more recently, by the appointment of field liaison representatives who serve as coordinators between the Soil Conservation Service and the Agricultural Research Service.

Effective cooperative relations have been maintained with the agricultural experiment stations of the Western States and Hawaii through official collaborators from each station, who serve as a connecting link between the staffs of the experiment stations and the Laboratory. They meet annually with the Laboratory staff to coordinate the experimental work, to review the research programs, and to make recommendations regarding future investigations.

The appointment of five field research liaison representatives and a national liaison officer, who are responsible to the Soil Conservation Service and the Soil and Water Conservation Research Branch of the Agricultural Research Service, is another step designed to improve the



Jetting rig for the installation of inexpensive observation wells (piezometers) used to determine fluctuations in groundwater levels and to log subsurface materials. Equipment developed by the cooperators on drainage investigations in the Coachella Valley, Calif.: University of California, Bureau of Reclamation, Coachella Valley County Water District, and the Salinity Laboratory.

Leaching operations in the Coachella Valley, Calif., showing contour borders This is a saline-alkali soil which will require leaching and the application of gypsum for reclamation.

transmission of research needs to research agencies and research results to those who are conducting action programs in conservation of soil and water and the improvement of agriculture. These liaison officers have the responsibility of keeping informed of the operating procedures of the Soil Conservation Service, of assisting both services in determining research priorities and the development of programs, and in channeling research information operating personnel.

The publications of the Salinity Laboratory provide an important means of making the results of its research available to cooperating agencies, professional agricultural workers, and those of the general public who are concerned with salinity problems. The Laboratory has published 185 papers and bulletins.

Included among these is Agriculture Handbook No. 60, entitled "Diagnosis and Improvement of Saline and Alkali Soils," which was issued in February of this year. It includes information on the origin and nature of saline and alkali soils, the principles involved in the determination of the properties of such soils, and the procedures to be followed in their improvement and management. Plant response to saline and alkali conditions is discussed, and lists showing the relative salt tolerances of crops are included. It also contains a chapter on the quality of irrigation water and the effect of various waters on soil conditions. Interest in the handbook is indicated by a worldwide demand and it appears that it may serve as an effective means of bringing the results of research at the Salinity Laboratory into practical use.

Family of Winners

By JOHN H. GIBSON

ORVAL LONG and his family make their living on a gently rolling farm in the Grundy Shelby area in Harrison County, Mo. They are in the Harrison County Soil District, and they have made an enviable record.

Let's look at a few of this family's accomplishments. In 1948, Orval was selected by the district board of supervisors as one of the outstanding conservation farmers in the Harrison County Soil District. He received a cash award from the Goodyear Tire and Rubber Company. In 1950, Larry, oldest son and then a 16-year-old FFA boy, won first place in the North Missouri contour plowing match, thus becoming eligible to compete in the national event whose ranks are usually filled with veteran competitors. Larry made up for his lack of experience by his youth and determination and took second place in his specialty of contour plowing. In 1950, 1951 and 1952, Orval won membership in the local 100-bushel corn club by producing more than 100 bushels of corn per acre on a five-acre field. In 1953, Gary, the second son, took his place in this contest by producing 116 bushels per acre. In the fall of 1952, four children of this family were stricken with infantile paralysis. To Jackie, the youngest boy, it was fatal. The others made satisfactory recovery, and Larry, although on crutches, is now an honor student at Northeast Missouri State College and Gary is winning honors in the family tradition.

Gary's most recent achievement was the winning of a brand new Ford tractor in the Missouri FFA Tractor Operators' Contest. This match was designed to assist dealers and Vo-Ag Teachers by instructing farm boys in: (1) safety, (2) daily and periodic maintenance of tractor

(Continued on Page 90)

Note:—The author is soil conservationist, Soil Conservation Service, Springfield, Mo.

A mountain stream rushing down to the valleys of Utah.

Books in Running Brooks

Each stream measures the way man has lived with nature and gives warning while the landscape may yet be saved from abuse.

By WILLIAM A. BREYFOGLE

ON A DAY to be spent out of doors, a brook makes a good companion and a fascinating study. Brooks have been friends and associates of men as long as men have been on earth, and not only of men but of all living things. They are living things themselves, if birth and growth, change and vital function can make them so.

When all the laws that govern the working of physical matter have been explored, when rainfall, topography, climate and vegetation have been thoroughly discussed, something about a brook is still unexplained. Dissect a bird in utmost detail and you have not accounted for its song. The brook has a song, too, to make good its claim to be something more than just an intricate mechanism. Machines may whir, but they do not sing.

A brook is running water in its earliest youth, just after it breaks from the earth. It is worth a scramble over rough ground and through tangled undergrowth to come at last to the pool, no bigger than a water pail, constantly astir with an impulse from the darkness beneath. Far away though it is, the mouth of the Mississippi or the St. Lawrence is implicit in the place. The stream flowing out of the pool is on its way to New Orleans or Tadoussac.

An inspection of its brooks will tell you much about the general health of a region.

They are the little veins in the earth's great circulatory system. In health, they carry nutrients for a host of plants and animals. In illness, their pollution can warn us that a landscape is being ruined while there is yet time to save it.

A steady current and clear water mean that the woodlands have escaped reckless cutting and that the topsoil formed over thousands of years has stayed in place, instead of being swept away like a spendthrift's money. The fishing will be better in this brook, animal and

Note.—This article is reprinted by special permission of the Editor from the April 1954 issue of *Natural History*.

plant life in the woods will be more abundant, and the farms near by will be more prosperous, better places to live. There is no sadder sight in nature, and none more alarming, than a watercourse shrunk to the merest trickle in the heat of summer, swollen to a muddy torrent by the surface runoff of spring. More ominously than any statistics, it proclaims a culture in decline.

One thing to be learned while loitering along a brook is that natural beauty is a matter of the first importance, not only to the artist but to the economist. A swamp with a profusion of pitcher plants and lady's-slippers, perhaps the rare little ram's-head; or a patch of hardwood cover where a fox still rolls in the sun in front of his earth—these are, quite literally, like money in the bank. They mean that a district has been settled and cultivated without being despoiled, that the people here are living within their income and leaving the truest kind of capital untouched. There is nothing sentimental about an interest in the preservation of wild flowers. They are of just as vital concern to a banker as to a botanist.

The brook exists not as a thing in itself but as a part of a highly complex system of symbiosis, which means "living together." In animate nature, there is no such thing as isolationism. Each individual life touches many others and at more than one point. The function of the brook is to carry off rainfall. But, besides that, it provides a home for trout and caddis worms and watercress. It gives drink to the farmer's cattle in a pasture below the woods, and it turns the miller's wheel, just as it once filled the beaver's pond. What must always be remembered is that the system of which the brook is a voice and a symbol is in such close and delicate balance that no part of it may be rudely changed without disrupting the whole. The trout in its pool and the wild orchid in the woods are at the mercy of the lumberman, or of the farmer, or the careless hunter who does not put out his fire. When the trout and the orchid disappear, the beauty and fertility of a whole district go with them.

Travelers along the modern highway that was once the old National Road, from Cumberland over the mountains to Wheeling and on across Ohio, sometimes smile at the disproportionate size of stone bridges built nearly a century and a half ago. But the bridges were not too big when they were put there; it is the streams that have shrunk as the great woods were cut down without any foresight in the scramble for land. Those old bridges are nothing to smile at.

It is a mistake to make a distinction between the world of nature and the world of mankind. Man's world is only a part of the larger one, and its vital processes are not suspended because he has settled to agriculture and built cities. On the contrary, his well-being still depends upon those processes, whether he lives along a country road or in an apartment-hotel in New York. He may try to shrug off what is happening on the hillsides or the riversides, but both are nearer than he thinks. The brooks still run for him, though he may seldom catch even a glimpse of them now.

(Continued on Page 90)

West Trout Brook in New York.

Bee Pastures in the Conservation Plan

By ARTHUR B. BEAUMONT

Staghorn sumac, a desirable source of pollen and nectar; adapted to dry, stony soils.

FARM conservation plans have been prepared for many specialty farmer groups including dairy farmers, market gardeners, and orchardists. But little special attention has on the whole been given an important group of food producers, the beekeepers. There are some 600,000 of them in the United States. In recent years SCS technicians in Worcester County, Mass., have been quietly developing techniques and procedures in this important field. They have met with considerable success in working with local beekeepers. This article constitutes a progress report.

The major value of bees to society is not in the honey and wax they produce, important as these products are, but in the pollination of fruit, vegetable, clover and other flowers. It has been shown repeatedly that wild insects cannot be depended on to give adequate cross pollination required by certain flowers. Where there are no domesticated honeybees, pollination is generally haphazard and fruit or seed set is meager.

Bees, like other living things, must eat. The food of bees is pollen and honey which comes from nectar obtained from blossoms, and they must have these substances throughout their working season. Since each plant species or variety has a definite though short blooming period, it is necessary to provide a variety of bee pasture plants which blossom at different times within the season. Honeybees, just as truly as cattle—their counterparts among the four-footed animals—are foragers, and bees, like beeves, must have a continuous supply of food. The honeybee is the only domesticated animal serving man that gathers its own food in the summer and stores a surplus for winter use. This it will do in amounts sufficient for its own needs, and also produce a surplus for man if he will provide adequate pasture.

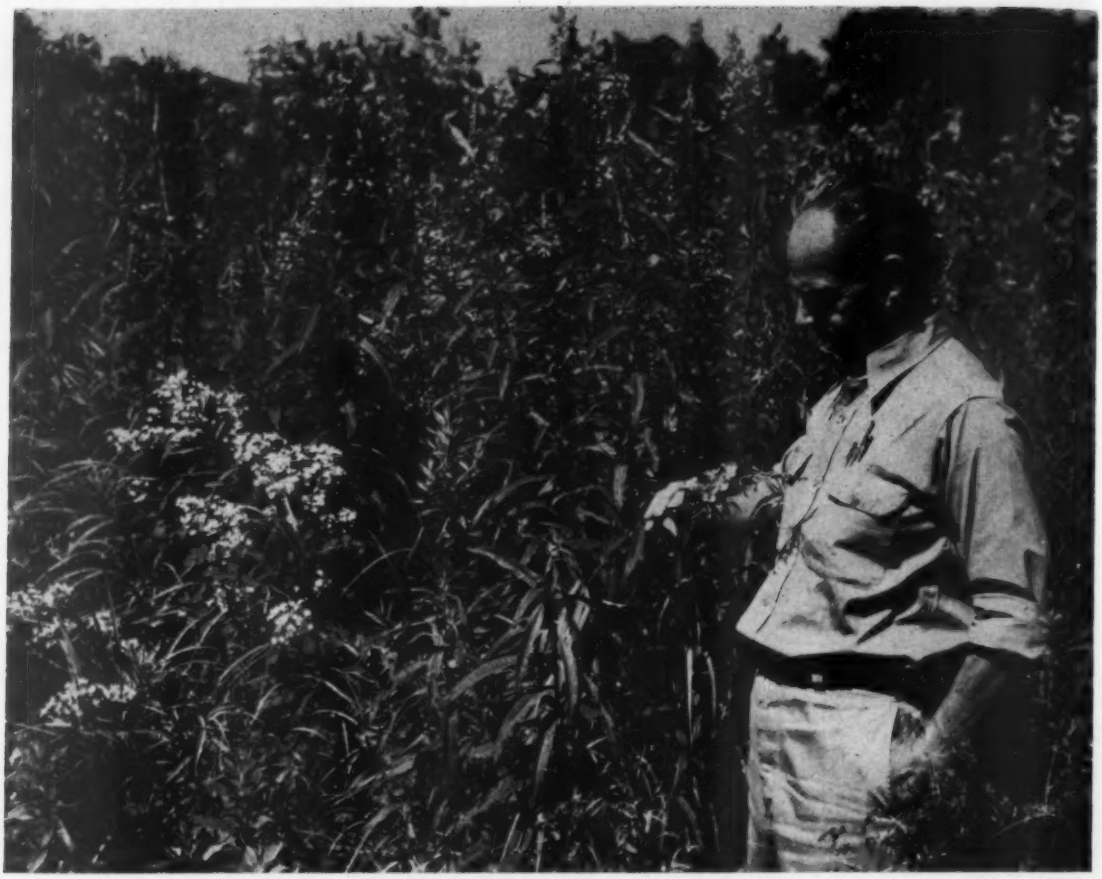
Note.—The author is state conservationist, Soil Conservation Service, Amherst, Mass.

Mr. and Mrs. Ralph Easterbrook and son Arthur, of Dudley, Mass., examine sweetclover sown on their farm for bee pasture. Bee pasture plan No. 1 was prepared for this farm. Easterbrook is a cooperator and supervisor of the Southern Worcester Soil Conservation District.

The national soil conservation program involves the use of a wide range of soil-conserving plants, among which are many nectar- and pollen-bearing species which are dependent on domesticated honeybees for seed and fruit production. The different sections of our country vary in the manner and the degree in which local programs are affected by the activities of bees. For example, sections in which clover is grown primarily as a seed crop must have a numerous bee population, but those in which clover is grown for forage only need no bees so far as that crop is concerned.

The bee pasture planner must know the bee-food value of plants and when and how long they are in blossom. He must know what plants are especially good producers of pollen and which are good sources of nectar. The planner must also know the soil and climatic requirements of these plants. The development of a soil conservation program for the beekeeper offers an excellent opportunity for promoting proper land use. An important element in this kind of planning is the means it affords of utilization of odd areas unfit for other kinds of agriculture. Many of the shrubs and trees valuable for bee pasture are well adapted to land classes VII and VIII.

Planning for bee pasture offers excellent opportunities for cooperation among neighborhood farmer groups. Since bees are thought to be able to forage economically within a radius of one-half to one mile, the beekeeper may well



Roscoe Johnson looks at "fireweed" (*Epilobium angustifolium*), a bee pasture plant in bloom in July. It is especially adapted to moist situations.

enter into some agreement with his neighbor to plant bee pasture plants. The beekeeper might profitably finance the planting of suitable pollen- and nectar-bearing plants on nearby farms.

The development of the technique of planning for bee pasture came naturally to Roscoe E. Johnson, soil conservation technician in the Northwestern Worcester County Soil Conservation District in Massachusetts. Johnson not only knows soil conservation, he also knows bees. He was a beekeeper for years. In fact, it was through his experience in keeping bees that he discovered the need for developing bee pasturage. He observed that a few colonies of bees could generally find enough food within economical flying distance but 10 or more colonies could not do so.

In assisting a beekeeper to plan adequate bee pasturage, the first thing the technician must do is to scout the farm and the vicinity for suitable pollen and nectar plants already available. These plants, and their quantities are listed in chronological order of blossoming. With this information at hand, the technician is then able to recommend species to fill in gaps. This is where technical knowledge of plants and their site requirements comes in. An example of how this procedure applies can be cited. An apple-grower who keeps bees primarily for insuring pollination purposes requested assistance. A careful appraisal of the situation revealed that a planting of sweetclover was all that was needed to complete the pasturage. The planting was made and is shown in one of this article's illustrations.

Herewith is a checklist of bee pasture plants suitable for Massachusetts conditions, which Roscoe Johnson has arranged in approximate chronological order of blossoming from April to November. Similar lists could be prepared for other states or areas. Those for the South and West would differ considerably from those of the Northeast.

1. Crocus
2. Skunkcabbage
3. Alder
4. Pussywillow
5. Poplar
6. Elm
7. Red maple
8. Spicebush
9. Cassandra
10. Weeping willow
11. Boxelder
12. Norway maple
13. Sugar maple
14. Cowslips
15. Gill-over-the-ground
16. Shad
17. Dandelion
18. Black birch
19. Pin cherry
20. Apples
21. Sassafras
22. Blueberries
23. Chokecherry
24. Tatarian honeysuckle
25. Red pine
26. Wild black cherry
27. Rugosa rose
28. Blackberry
29. Raspberry
30. Black locust
31. Orange hawkweed
32. White Dutch clover
33. Ladino clover
34. Alsike clover
35. Yellow sweetclover
36. Grapes
37. Multiflora rose
38. Alfalfa
39. Sumacs
40. Dogwoods
41. Dogbane
42. Winterberry
43. Milkweed
44. Fireweed
45. Sweet pepperbush
46. Purple loosestrife
47. Hollyhock
48. Cattails

(Continued on Page 96)

Everlasting sweetpea, a good source of nectar during August; long lived.

Load by Load, They Put It Back!

Up-and-down rows, winter storms, gouged away the topsoil. This is a fair sample of the 35-acre field mentioned in this article.

By J. M. RABDAU

IN what is believed to have been the first field demonstration of its kind, 50 FFA and 25 4-H youngsters, and about a dozen GIs who are in agricultural training in Latah County, Idaho dramatized the heavy losses that farmers and ranchers suffer when uncontrolled runoff sweeps over their sloping fields, cuts channels and carries away many tons of topsoil.

These young volunteers bent to their task at the business ends of shovels and at the handles of wheelbarrows, and put the topsoil, *at the rate of 93 tons per acre,* back where it had been gouged out by last winter's storms.

Four hundred farmers, and others deeply interested in soil and water conservation, saw the boys do the job and learned what erosion means. Through newspapers, radio and TV, many other farmers, and almost everybody else in the Latah district and adjacent areas, came to realize that what appears to be slight washing quickly adds up to terrific soil and crop losses per acre. The domonstration reached right down into their pocketbooks.

The storm damage was done in 4 months last winter at the Snow Brothers farm, south of Moscow, where the demonstration was held. It extended across the slopes of a 35-acre field. The restoration was made on a tenth of an acre, where the slopes ran about 25 percent. The damage occurred because the operators had worked the soil too finely, and had seeded it in drill rows running up and down the slope, rather than on contour and across the slope, the way the Snows generally handle their cropland.

In the demonstration, 114 wheelbarrow-loads of topsoil were recovered from where it had been deposited at the base of the slope. It was shoveled into the barrows, pushed up the hill on planked runways, and put back in place, with

Note.—The author is work unit conservationist, in the Soil Conservation Service unit which assists Latah (Idaho) Soil Conservation District.

careful compaction, thus restoring the face of the land to a condition under which normal operating and production methods can be resumed without interruption.

This much topsoil meant moving 29,416 pounds of earth, a net of 18,611 pounds of soil after the 30 percent moisture content had been deducted. These are banker-exact figures. The agricultural representative of a Moscow bank, and the manager of another Moscow bank, did the weighing at tested scales when the boys moved up the grade with their loads and when they came back with the empty barrows.

Twenty-five man-hours of work were required in the restoration operation. This indicates that a total of 1,093 man-days work (3½ man-years) would be needed to do a like job over the entire 35 acres. At $10 per day, it would represent a cost of $10,900.

On top of that, there is another angle in the loss that erosion causes. The technicians made a test for nitrogen content and found 1.435 pounds in the one-tenth acre. Since 2 pounds of nitrogen are required to produce a bushel of wheat, according to calculations by Roy Harder, University of Idaho agronomy department, the loss of nitrogen (1.435 times 18,611, the net loss of soil) gives a practical idea of the total loss per acre when productive farmland is eroded. Orval "Red" Snow, one of the farm owners, summed up that situation in this comment: "It's what you get when you don't farm on the contour."

The idea for a soil loss and recovery demonstration was hatched out by John T. Nicholas, a member of the Soil Conservation Service field unit that assists the Latah Soil Conservation

Men at work! Displaced topsoil was shoveled up at the base of the slope, carefully weighed, toted back up the slope in wheelbarrows, and dumped into the gaping holes.

Some of the channels were 14 inches wide and more than a foot deep. John T. Nicholas here measures some of the damage.

Final step was to compact the topsoil. In another year it should again be productive.

District. He organized his associates in the unit —Lawrence Sorensen, Manning Onstott and Harold Fulgenhauer—in a committee, of which he was chairman. They enlisted the sponsorship of the district supervisors, who helped gain the cooperation of newspapers, radio and TV, the Moscow Chamber of Commerce, County Agent Elbert McProud and the Extension Service, the agronomy department of the University of Idaho, and others. Included were farm machinery and supply dealers, lumbermen, millmen and builders, grain growers and commission men, and other businessmen, who supplied tools, equipment, materials needed for the work, prizes, and refreshments for workers and spectators. The Moscow high school band played lively tunes that kept the young workers on the move, and the spectators on their toes. Boy Scouts aided in parking cars.

Chapters of the Moscow, Troy and Genesee Future Farmers of America, the Latah County 4-H clubs, and the GI Agricultural Training Classes at Troy and Moscow provided the 90 volunteer workers.

All in all, it was another bang-up achievement for Johnny Nicholas, and spoke well for the teamwork of work unit and district. Nicholas is a veteran. He started farming in Nebraska, got caught up in the dust bowl debacle, came west to the land utilization project, and 6 years ago, transferred to Moscow. We all hope that he stays a long while. I still marvel over how he gets up so many good sound ideas and carries them through. In meeting people in all walks of life, and in getting them stirred up to action, I've never seen his equal.

BOOKS FROM RUNNING BROOKS

(Continued from Page 83)

But it is a pity if he does not. For, quite apart from their importance in the scheme of things, there is nothing more beautiful than a brook in being. Much that it has to say may be apprehended rather than understood—the pattern of water in sunny shallows and the way willows lean out over a pool, a muskrat making his purposeful way upstream, a kingfisher diving. Where the stream flows through woods, crows have an officious way of policing its course, crying aloud to all whom it may concern that something is moving down there. On a quiet stretch, the water striders make nothing of what is no miracle to them. Much higher than the noisy crows, a hawk soars, ready to plummet earthward when his prey slips down to drink. The swirl in the water just ahead may be a mink at his fishing.

A brook is a busy place, not only in its own primary work but in the variety of life it supports or attracts. And its beauty is informed with all this vitality, which is perhaps what gives it universal appeal. It is very much a part of the world that all living things inhabit, and a most sensitive indicator of the state of health of its own part of that world.

It used to be said that true intellectual curiosity could begin anywhere and find one subject leading into another until the whole realm of knowledge and understanding had been included. Certainly, given leisure to explore all its aspects, this is true of a brook, and it may be only another way of saying that the world is one world, not divided into compartments but to be understood, if at all, as a whole. The study may be as profitable as we wish to make it and as delightful as an afternoon along a brook's course. Surely it is true that there is hope for every people so long as they have not let their brooks run dry.

FAMILY OF WINNERS

(Continued from Page 81)

and plow, (3) field adjustments, (4) operation of equipment and plowing skill.

Gary first had experience in plowing contests when he competed and won first place in the junior division of the North Missouri plowing match in 1950, and naturally he assisted his big brother Larry in winning second place in the National Plowing Match. It appears that this FFA contest was made to order for Gary. After being selected by his own FFA chapter to represent them, Gary battled his way through the county, district and state contests. It has been reported that Gary spent some 70 hours in practicing plowing alone and countless more hours studying and reviewing the operator's manual for tractor and plow.

The winner of first place over six of the outstanding FFA members, is a great accomplishment, but it fits the pattern of living and farming being done by this family.

Bankers Spur Work

By ARTHUR SULLIVAN

THE Colorado Bankers Association always has shown an active interest in agriculture, Colorado's largest industry. This interest has been emphasized at all of our bankers conventions. It is no wonder, then, that 8 years ago we took a definite step to recognize what our farmers and ranchers were doing to safeguard our most valuable asset, the soil.

Having been reared on a farm, my own concern was naturally for the welfare and improvement of agricultural conditions. I became interested in the soil conservation district movement in 1946, and I had the pleasure of helping organize the Haxtun Soil Conservation District in northeastern Colorado.

This year, too, I was appointed chairman of the agriculture committee of the Colorado Bankers Association. I attended the board meetings of the district as often as business would permit. We developed some ideas which the Haxtun Soil Conservation District was able to use to great benefit. Among the conservation practices which have made our community a better place to live are windbreak plantings, stripcropping, dams, grass-seeded diversions, contour farming, terracing, irrigation wells, and many others.

In going over the farms on tours, and on other occasions, I have marveled at the fine jobs that our farmers are doing not only for themselves but for all of us. *How could we give recognition to these men and stimulate others to do likewise?* This question kept running through my mind. It also was being pondered by J. C. Scarboro, secretary of the Colorado Bankers Association. Scarboro and I finally—convinced of its importance—called a special meeting of the agriculture committee and began to make plans for the Colorado Bankers Association Soil Conservation Achievement Awards Program.

Our first Achievement Award Program was held at Mosca, Colo. It was decided to hold the first meeting in the Mosca-Hooper Soil Conservation District because it was the home of L. B. Casselman, president of the Colorado Association of Soil Conservation Districts. The meeting was a real triumph. Bankers, businessmen, and farmers and ranchers gathered to pay tribute to the district cooperators and their wives who had completed 90 percent of their conservation program. Since that time, similar meetings have been held in practically all sections of the state.

In northeastern Colorado we have conducted the program each year at Sterling. Here the high interest and enthusiasm has made it one of the outstanding agricultural events of the year. We have endeavored to bring in some outstanding speaker known for his interest in the conservation movement and the general welfare of agriculture among them Monsignor Hildner, "the fighting priest," from Villa Ridge, Mo.; Tom Glaze, head of agricultural research, Swift and Company, Chicago, Ill.; and Robert Wilson, vice-president, Goodyear Tire and Rubber Company, Akron, Ohio. They have left inspiring messages that have done much to stimulate progress in conservation.

Bankers in other sections of the State are following the same pattern.

The appreciation of these Awards of Honor can be described best by citing one incident. At the home of one of our recipients a daughter was displaying her high school diploma to neighbors with a great deal of pride. Her father, who had recently received his Banker Award of Honor, indicated he too had a diploma; thereupon he brought forth his Soil Conservation Achievement Award from the Colorado Bankers Association. He was as proud of his special honor as was his daughter of her high school diploma.

While this program has taken time and effort, the returns have been great. In these few brief years, we have seen much progress made in the conservation movement. There remains much to be done. If our efforts have helped guide farmers and ranchers toward doing a better job of soil conservation, and a wider diversification of their agricultural enterprise our efforts have been well rewarded.

Seven Weeks of Living with Soil and Trees

By R. N. HOIT

Walter R. Pridmore explains to a group of Scouts the value of woods as a means of protecting the soil from erosion.

DURING a period of 7 weeks last summer, 577 Boy Scouts of the Anniston, Ala., area had an opportunity to learn more about soil conservation, as they emphasized their "National Conservation Good Turn" program at Camp Zinn.

Two representatives of the Soil Conservation Service—W. V. Harlin, soil scientist, and Walter R. Pridmore, conservation aid—were among the instructors. Others who assisted in the conservation program were Jake Matthews, assistant county agent, Talladega County, in charge of forestry; Lynn Kidd, forester, State Department of Conservation; and Foresters John B. Graves, Alabama Power Company, Ken Rolston and Bert Carlson, Coosa River Newsprint Company; Tom Brickman, Rome Kraft Corporation; and Storey Edwards, Bowater Corporation.

A forester or SCS man worked with the boys a full week as a member of the camp staff.

Note.—The author is area conservationist, Soil Conservation Service, Anniston, Ala.

Harlin spent an afternoon each week explaining soils—how they are formed, how they should be protected. The Scouts studied topsoil, learned how it develops from subsoil, grading into bedrock, the parent material of all soils.

On a field trip to a nearby farm, the Scouts saw examples of soil conservation practices. They were shown how good ground cover, such as trees, pasture, hay, and forage crops, protects the soil from the rain.

Two bottles, one containing muddy water from an unprotected area, and the other containing clear water from a well-managed forest were kept at the conservation den as a reminder of what happens when soil does not have a proper protective cover.

At the end of each week a short test was given to see what had been learned. The Coosa River Newsprint Company awarded a saw to the boy who made the highest score.

Scout Executive DeWitt Thompson said this was one of the biggest and most successful camps that Choccolocco Council has had.

Reverse Irrigation

By HYLON C. SMITH and WILLIAM R. RATLEDGE

MAY was a dry month. June followed with an even greater promise of hot, dry weather. John Annett of Staytonville, Del., looked at his drying fields and made a decision. He asked the Soil Conservation technicians from the two districts serving his farms for assistance in establishing an irrigation system.

This is a familiar beginning to many stories on how a farmer received help through his local soil conservation district. If followed to its completion, the story would tell you how the farmer saved many acres of string beans, thanks to his new irrigation system, supplied by water from three dugout ponds built in just the nick of time. All of this is true, but it is not the story we want to tell.

John Annett has a farm in Sussex County, Del., where the soils generally are quite sandy. The soils range from very droughty to very wet. Fields where irrigation may be needed during one week may require drainage the next. In some fields irrigation is a must on sandy ridges, and a must-not on flats and pockets where the soils are poorly drained. These problems were discussed by Annett and the technicians, and a plan was made to provide much of the necessary drainage in conjunction with the irrigation system. It seemed a little odd to see a dragline at work building ditches in a field while the irrigation system was pumping water from a newly dug pond in the same field. Neighbors for miles around envied the irrigation system as crops parched during late June; they watched the construction work and questioned the wisdom of ditches while crops burned up.

What makes this a different story? Reverse irrigation! The first 4 days of July brought some nice showers to supplement the irrigation, but July fifth brought a young flood. More than 3 inches of rain fell in the space of a few hours on the Annett farm. The newly dug drainage ditches filled and carried water to the pond. After the rain, many small ponds were scattered throughout the fields where drainage ditches were not practical and tile drainage was impossible. Crops were threatened with drowning and scalding, and some with weed damage, if the water could not be removed. John Annett was equal to the occasion. He reasoned that if his irrigation system would pump water out of the ditches it could also pump it back in. The portable pump and pipes were quickly put to work and a surface tile line soon moved the water from the ponded areas to the newly dug ditches. John Annett is now able to cultivate his crops while many of his neighbors are still waiting for the ponds to dry up.

John Annett, wth rare ingenuity, saved a crop from drowning by performing a drainage operation with an irrigation system.

Note.—The authors are respectively, supervisor, Sussex County Soil Conservation District and work unit conservationist, Soil Conservation Service, Georgetown, Del.

Curved Fields vs. Square Ones

There is no substitute for personal experience. This is the story of one farm and one man. Together, they discovered the methods and rewards of conservation.

By VILLARD W. McLAUGHLIN

AS A BOY I worked on the farm I am now operating, near Dyer Brook, Maine. We had square fields, and the points of the compass were used as guides. We learned everything we could about raising good crops of potatoes. The farm has 86 acres of cropland, 14 acres of hay land, and 33 acres of woods. The woodlot is on a very steep slope just above the fields. Very little of the cropland slopes more than 4 to 10 percent. Every spring, and often in the summer and fall, water would run from the steep slope and over all the fields north, west, and south, taking soil and fertility with it. My father often remarked that some day the whole farm would be down in the brook and he didn't know what to do about it. He tried everything he thought might help but he could not stop the water damage. It used to be a good farm but crops were getting poorer.

I took the farm over in 1939 and began farming in strips on the contour. That same year my neighbor across the road, who always had had similar trouble with water washing his fields, made an effort to stop it. The next spring I went over his fields and found that they had not washed. He told me that through the Extension Service he had been helped by some Soil Conservation Service technicians who were located in Presque Isle on a demonstration project there. I asked these technicians to look over my farm and advise me what to do.

Note.—The author was active in the organization of the Southern Aroostook Soil Conservation District. He has served continuously as secretary-treasurer from the beginning, and also served as president of the Maine Association of Soil Conservation District Supervisors. His conservation farm plan was in effect before the district was organized in 1941.

District Finds Our Magazine A Good Investment

FROM De Smet, S. Dak., comes a report which ought to be helpful to many soil conservation districts searching for a way to plant vigorous new ideas among their cooperating farmers. Harold C. Fritzel, the treasurer of the Kingsbury County Soil Conservation District, joins with Arthur Brose, chairman, in writing:

"We have just recently sent an order to the Superintendent of Documents for 79 one-year subscriptions to SOIL CONSERVATION, the official organ of your Service.

"Our total subscriptions, to date, amount to 655. This is the sixth consecutive year we have furnished our new cooperators subscriptions to your magazine.

"I would like to add that our board of supervisors believes it is a means of attaining and retaining good cooperative relations with our cooperators, as well as informing and alerting them to the many possibilities in the field of soil conservation.

"The matter of subscriptions was brought up at our July meeting, moved, seconded and unanimously approved within 30 seconds."

The plan which they worked out surely looked funny to me. The new map did not look like the farm at all. There were to be no more of the square fields and straight rows with which I was so familiar. But I realized that the way we had been farming, even though we had been following all the latest recommendations for growing potatoes, we were not going to get the crops I would need if I were to keep on farming. I decided that this new plan might be the answer. So I told the technicians to lay it out. I would dig ditches and follow their recommendations on rotations and general management.

That summer we dug 4,300 feet of outlets, 6,200 feet of diversion ditches, and laid out the whole farm in contour strips. Later on, I dug a pond, took some ledge outcrops from the fields, and did some improvement in the woods. As time went on, minor changes were made in one or two of the ditches.

There are still a few trouble spots in the hay land which I hope to find a way to take care of, perhaps putting some of the land in condition for potatoes. In dry years this field yields the best of any part of the farm, but it cannot be depended on every year.

In 1940, my farm was rated as the lowest producing one in the area—an average of 90 barrels per acre per year. I have no record of yields for the next 3 or 4 years, but I know they increased. During the last 10 years I have had about 160 barrels per acre consistently. Hay and grain crops are also better. I believe that these better yields are a result of keeping the soil and fertility where they belong; more of the water is being stored in the ground for the crops since I began using strips. I know of farms planted up and down the slopes which yield much better than mine when the rainfall is above average, but in dry years their yields are much lower.

During the war I did not increase my potato acreage above that provided for in my farm plan. I felt that if I did I would undo what had already been accomplished in building up the farm. I saved what was left of my farm, I am getting consistently good yields, and I have the satisfaction of knowing that the farm will be in much better condition for my son to operate than it was when I took it over. This is why I believe in conservation farming.

"Dead" Soil Comes To Life

By W. R. ELDER

SEVEN hundred and eighty pounds of lint cotton per acre!

That sounds like an irrigated crop. But Clinton Harbers made the yield in 1953 on a flat Blackland bench along the Colorado River northeast of La Grange, Tex. The rainfall was no more than normal. As Harbers tells it, the picture of a streamlined cotton factory comes to mind.

When Harbers returned from war, he bought the 100-acre farm of his boyhood. Land, machinery, seed and fertilizer put him $34,000 in debt.

The farm in 1946 was far from Harbers' dream of what it ought to be. The heavy clay soil was in bad condition. Here and there the land was poorly drained. Cotton yield was 125 pounds of lint per acre. The previous owner had made about $500 net the year before. There were innumerable problems, not the least being that $34,000 debt.

Harbers needed help in laying out drainage ditches on the farm, and he got it from the Soil Conservation Service. A soil survey revealed some of his major problems. This topsoil, though very deep, was dead. It was low in organic matter, had a bad plow pan, and was deficient in air space and fertility. Harbers saw he was not altogether correct in his belief that drainage and fertilizer out of a sack would make high yields.

As Harbers developed his coordinated conservation plan as a cooperator with the Bastrop-Fayette Soil Conservation District, he began to visualize the "assembly lines" needed to supply the water, air, and fertility for the cotton. Since the soil supplies all of these to the plant, it would have to be changed from its poor condition, he realized.

Harbers drained the land and started growing legumes. To open up the soil far down, Harbers first tried *melilotus indica*, then dis-

Note.—The author is soil scientist, Soil Conservation Service, Temple, Tex.

carded it in favor of Hubam clover. Fall-planted Hubam, with 200 pounds of 16-20-0 fertilizer under it, on a fourth of the land each year, took care of the deep "opening up." This let the cotton roots go far down for water, air, and fertility. Harbers let the Hubam go to seed, and grew no cotton on the clover land in the same year.

Harbers put a winter cover crop on the other three-fourths of his land to protect the soil and add organic matter. He tried Austrian winter peas, and hairy vetch but presently began using Willamette vetch instead. Fertilized with 200 pounds of 16-20-0 each year, the Willamette produces a larger tonnage of organic material than Austrian winter peas or hairy vetch.

When all of the land was covered with legumes, the Harbers cotton factory began producing. With Hubam clover for organic matter down deep, and vetch for a yearly "shot in the arm" of fresh, rapidly decaying material, the soil was in condition to catch and store most of the rain that fell. There was plenty of air in the soil for the roots to breath. The legumes released fertility steadily during the summer to feed the growing cotton.

Because of his investment in legumes to keep the soil open and alive, Harbers couldn't afford to destroy its sponginess with ordinary plowing or bedding. So he used a chisel plow to keep the residue on the surface. On the plow frame he built fertilizer boxes and small-seed planters so that two rows of vetch could be planted and fertilized at the same time. With this tool he plows the land in the fall and, after a disk-type bedder throws up small beds, puts fertilizer down in two bands on the sides of the beds. The small-seed planter seeds the vetch above the fertilizer in the same operation.

In the spring Harbers undercuts the vetch on the beds with sweeps. Then a disk harrow, set straight, chops the vetch up. The disk bedder, reversed, clears the top of the bed of the vetch. Cotton then is planted on top of the undisturbed bed. Stands have always been good as the bed is firm and no moisture is lost in stirring. The vetch straw is moved back against the cotton as a mulch to save moisture and control weeds.

Insect control is early, and effective. At the two-leaf stage, a series of 9 sprays and dusts is begun and completed in 63 days. *The natural enemies of the destructive insects are allowed to come in and take over the control job. By the time bollworms arrive on other cotton fields, Harbers' cotton is at the gin.*

In 7 short years Harbers' cotton factory has come into full production. In 1947 the yield was 125 pounds of lint per acre; in 1948, 250 pounds; in 1949, 500 pounds. As the organic matter and moisture-storage capacity of his soil have increased, Harbers has had to increase the number of cotton plants to keep the size down so the stripper can be used to harvest the crop. He grows 80,000 plants per acre instead of the usual 40,000 plants.

Harbers' cotton factory is a reality now. Just as a factory assembly line brings materials to the right place at the right time, Harbers' soil gives the cotton what it needs at the right time. Hubam clover solved the soil's tightness with its deep roots. Vetch put the winter roof over the soil and picked up the fertilizer for summer delivery to the growing cotton. Limited tillage maintains the soil's porous structure which was built by the clover and vetch. Efficient control protects the cotton from insect damage. Once-over mechanized harvesting puts the finished product at the gin.

Is Harbers' cotton factory successful? The answer is clear. The $34,000 debt is paid and the $500 annual net income has grown to $15,000. The 125 pounds of lint per acre has increased to 780 pounds. The once dead wet soil, with less than 2 percent organic matter, is now a live, open, highly productive, well-drained soil with 3.2 percent organic matter.

BEE PASTURES

(Continued from Page 87)

49. Basswood
50. Meadowsweet
51. Hardhack
52. Buttonbush
53. Joe-pye-weed
54. Boneset
55. Snakeroot
56. Goldenrod
57. Asters
58. Baltonia
59. Witch-hazel

Planning bee pasturage as a part of the conservation plan has passed the experimental stage in Massachusetts. Beekeepers are intensely interested in it, and a number of conservation plans incorporating this phase of planning have been prepared.

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